APPLICATION FOR
UNITED STATES LETTER PATENT

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

Be it known that we, Edward F. McNair, a citizen of the United States, resident of the State of Iowa, having a postal address of 3147 R Avenue, Adel, Iowa; and Richard C. Burhans, a citizen of the United States, and resident of the State of Iowa, having postal addresses of 3072 Timber Trail, St. Charles, Iowa, have invented new and useful "GEOTHERMAL PIPE WEIGHT", of which the following forms the specification.

"GEOTHERMAL PIPE WEIGHT"

CROSS REFERENCE TO RELATED APPLICATIONS

Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

REFERENCE TO MICROFICHE APPENDIX

Not applicable.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to an apparatus for geothermal wells. More specifically, the present invention relates to a method and apparatus for providing weight and rigidity to the piping used in vertical wells drilled for ground-source heat pumps. The invention is used to aid in inserting the piping, along with a tremie pipe, into the well.

Background Art

Heat pumps typically exchange heat between an indoor space and the ambient. The coefficient of performance for both the heat pump cycle as well as the refrigeration cycle is usually significantly enhanced by using ground water for the ambient because the temperature of the ground water is fairly constant at temperatures often closer to the desired indoor space temperature than the outdoor air.

To make adequate contact with the ground water, vertical wells 200 to 300 feet deep are drilled into the ground in the neighborhood of the indoor space being heated and/or cooled.

A loop of piping made of a polymer such as SDR 11 virgin polyethylene resin is inserted into the drilled well. Two pipes are involved with an elbow connecting the two at their lowest extremity in the well. The well will be completely or partially filled with water, clay, mud, sand, etc., any of which impede the insertion of the piping loop. Besides the possibility of frictional resistance to insertion, the plastic, having a density less than water, is buoyant – even when filled with water. To overcome the frictional as well the buoyancy forces, additional weight must be included with the piping. Present practice includes the use of concrete reinforcing rod and junkyard scrap iron to increase the weight of the piping for insertion. None of these materials are approved by the appropriate state organizations such as the Department of Natural Resources (DNR), or equivalent, or the appropriate federal organizations such as the National Sanitation Federation (NSF) and the Environmental Protection Agency (EPA) for contact with ground water.

The piping products used in these geothermal installations are delivered in a roll. Because the piping material has "memory," it will retain some curvature during the insertion process, impeding the movement of the pipe into the well.

There is a need, therefore, for a system for adding weighting materials approved by the appropriate organizations (e.g. DNR, NSF, EPA, or equivalent) to the piping loops inserted into a geothermal well for a ground-source heat pump. There is additional need

for a system for straightening and maintaining the straightness of the piping during the insertion of the piping into the well.

BRIEF SUMMARY OF THE INVENTION

Two problems present themselves when piping is inserted into a well for a ground-source heat pump system:

1. The pipe, even filled with water, is buoyant in the contents (mud, sand, water, etc.) of the well, and may require significant force to keep it from floating back out of the well.
2. The pipe, having been stored in a roll, retains some curvature making it difficult to insert into a straight-bored well.

Therefore, one object of the present invention is to provide a system whereby weight may be added to the piping before and during insertion into the well. An important and related object is to provide such extra weighting in a manner that is approved by the DNR, NSF, and/or EPA (or equivalent) for insertion into the ground water.

Another object of the present invention is to provide a system for straightening the pipe that is inserted into the well, and maintaining that straightness during the installation.

It is advantageous that any weight added to the geothermal well piping be as dense as possible. Examples of materials that may be used comprise iron, steel, and concrete. In a separate embodiment, straight pipes may be filled with dense material such as sand, then sealed at both ends.

Some materials, notably iron and steel, are not suitable for contact with ground water according to the states' DNR and/or the federal NSF and EPA. To make these materials useable for the present purpose, they must be sealed in a coating that will exclude water and remain intact indefinitely. Examples of such sealing materials are polyethylene and powder coatings. Concrete need not be coated, but if steel is used to enhance the tensile strength of the concrete, the steel must not come into contact with the ground water.

If pipes filled with sand are used, the piping material must be approved by the appropriate organizations such as the DNR, NSF, and/or EPA. The same materials used for ground-source heat pump pipe are suitable.

Insertion of the geothermal system piping into the vertical well is made more difficult due to the pipe's shape memory. Because such piping is delivered on rolls, the pipe tends to retain some curvature. If the pipe is stretched out in the sun on a warm day, the curvature may be reduced or even eliminated, but the pipe also loses rigidity, making it difficult to work with. The weights described above may be configured to provide the straightness and rigidity needed to insert the pipe into the well.

Weights may be made in sections for ease of handling. The sections must be stackable in a fashion that provides rigidity to their joints, thereby making the whole substantially rigid. The weights are constructed with any of a number of various interlocking ends. The weights are typically affixed to the geothermal piping with tape. Tape at or near the ends of each weight help ensure the rigidity of the connections.

Weights need only be added to a lower portion of the geothermal piping. Tape is wrapped around the weight and ground-source heat pump pipe every several feet. The tremie pipe is also taped, but only sufficiently to secure its travel into the well. The tremie pipe must be broken free to pull up when grouting the well.

Clamps may also be incorporated to expedite the process of attaching the pipes to the weights.

The novel features which are believed to be characteristic of this invention, both as to its organization and method of operation together with further objectives and advantages thereto, will be better understood from the following description considered in connection with the accompanying drawings in which a presently preferred embodiment of the invention is illustrated by way of example.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Fig. 1 is a schematic of a heated structure and a geothermal well with geothermal piping therein;

Fig. 2 is a perspective view of a section of ground-source heat pump piping with a web separating two such pipes;

Fig. 3 is a perspective view of the section of ground-source heat pump piping with a tremie pipe and weight attached;

Fig. 4 is a section view of the ground-source heat pump piping with a web separating two such pipes and a tremie pipe and weight attached;

Fig. 5 is a section view of a specially shaped weight with ground-source heat pump piping and a tremie pipe attached;

Fig. 6a is a perspective view of the specially shaped weight of the present invention;

Fig. 6b is a perspective view of the specially shaped weight ground-source heat pump piping and a tremie pipe attached;

Fig. 7 is a side elevation view of solid geothermal pipe weights having cone-shaped interlocking ends;

Fig. 8 is a side elevation view of filled pipe type geothermal pipe weights having cone-shaped interlocking ends;

Fig. 9 is a side elevation view of geothermal pipe weights having threaded interlocking ends;

Fig. 10 is a side elevation view of geothermal pipe weights having pin and socket interlocking ends;

Fig. 11 is a perspective view of specially shaped weights with pin and socket interlocking ends;

Fig. 12 is a side elevation of a further embodiment of the present invention wherein the weight hangs beneath the geothermal piping;

Fig. 13 is a section view of the ground-source heat pump piping showing two geothermal pipes, a tremie pipe, and a weight attached with tape;

Fig. 14 is a section view of a specially shaped weight with geothermal piping and a tremie pipe attached with tape; and

Fig. 15 is a section view of a specially shaped weight with geothermal piping and a tremie pipe attached with clamps.

DETAILED DESCRIPTION OF THE INVENTION

The indoor environment of a structure **100**, shown in **Fig. 1**, is controlled. For heating as well as cooling, heat is exchanged with the ground and ground water via geothermal piping **110** that was inserted into a vertical geothermal well **120**. The geothermal piping is connected to a ground-source heat pump (not shown). Water circulating in the geothermal piping **110**, exchanges heat with a condenser within the ground-source heat pump for cooling duty or an evaporator within the ground-source heat pump for heating duty.

An example of a section of some geothermal piping **110** for use with a ground-source heat pump is shown in **Fig. 2**. A web **210** connects the two pipes **110** and provides separation to reduce heat transfer between the two pipes.

The same geothermal pipes **110** as shown in **Fig. 2** are shown in **Fig. 3** along with a weight **300** and a tremie pipe **330**. The weight **300** comprises a heavy core **310** that may be made of steel, iron, or concrete, and a water impervious coating **320** such as polyethylene. Such a coating **320** makes the weight approvable by the appropriate organizations such as the DNR, NSF and/or EPA (or equivalent) for contact with ground water. No coating **320** may be necessary for some core **310** materials such as concrete. The cross section of the weight **300** shown in **Fig. 3** is circular, but the present invention is not limited to any particular cross sectional shape. All these components, the two geothermal pipes **110** (whether separated by a web **210** or not), a weight **300** and the tremie pipe **330** are typically bound together using tape **1310** such as duct tape or electrical tape or similar as shown in **Fig. 13**.

The geothermal pipes **110**, tremie pipe **330** and weight **300** are shown in plan view in **Fig. 4**. The web **210**, again, separates the two geothermal pipes **110**.

A second embodiment of the present invention is shown in plan view in **Fig. 5** and perspective views in **Figs. 6a** and **6b**. In this case, the weight **500** has a special cross sectional shape to receive the geothermal pipes **110** and the tremie pipe **330**. To define the cross sectional shape of the weight **500**, we begin with a substantially square rectangle with rounded corners. Each of the four substantially equal sides is curved inward, toward the center of the rectangle in substantially circular arc shapes to receive the geothermal pipes **110** and tremie pipe **330**. The shape described and illustrated is hereby defined as a *modified receptive square*.

In this embodiment, the geothermal pipes **110** are not separated by a web. These special weights **500** are stacked end to end in use and coupled by mating pins **510** with sockets **520**. The special weight **500** is shown in **Fig. 6a** with no attached piping, while in **Fig. 6b**, the geothermal pipes **110** and the tremie pipe **330** are shown in dashed lines in position on the special weight **500**. The piping, both the geothermal pipe and the tremie pipe may be attached to the special weight **500** using tape **1310** as shown in **Fig. 14** or by clamps **1510** illustrated in **Fig. 15**. The clamps **1510** may be flexible or rigid. Therefore, the clamps **1510** may be made of plastic or cast into the special weight **500**, for instance.

It is important that, whatever form the weights **300**, **500** take, they may be coupled end to end such that some rigidity is imparted to the geothermal pipes **110**. Some examples of such end couplings are illustrated in **Figs. 7–10** for the first embodiment of the weight **300**. A conical insert **710** is inserted into a matched conical socket **720** in **Fig. 7**. The weights **300** depicted in **Fig. 7** have a ferrous material core **310** such as steel or cast iron coated with a water impervious coating **320** such as polyethylene; or the weights may be made of concrete with no coating. **Fig. 8** depicts a weight **300** constructed by filling a DNR, NSF, and/or EPA (or similar) approved pipe **830** with sand or other dense material. The insert **810** and socket **820** are fittings – threaded or glued onto the pipe **830**.

A system for threading the weights **300** together is shown in **Fig. 9**. A male thread **910** is provided at one end of the weight **300** while a female bushing **920** is used at the other end of the weight **300**.

A right circular cylindrical shaped peg **1010** with a right circular cylindrical shaped socket **1020** provide coupling in **Fig. 10**. The coupling systems shown in **Fig. 9** and **10** may be used with either a solid weight **300** such as ferrous material/coated version or a filled pipe **830** version.

The second embodiment of the present invention is shown in perspective in **Fig. 11** illustrating the coupling of two special weights **500**. The cross section of the special weight **500** is symmetric about a line passing through the centers of the pegs **510** and also about a line passing through the centers of the sockets **520**. Therefore, by rotating the special weight **500** 90° on its longitudinal axis, the pins **510** may always be aligned with the sockets **520**.

A third embodiment of the present invention is shown in **Fig. 12**. A weight **1200** hangs from a hanger **1210** attached to an elbow **1220** at the bottom of the geothermal pipes **110**. A rope or coated metallic wire or cable is used to attach the weight **1200** to the hanger **1210** via a loop **1240** made fast to the concrete weight. The loop is also made of rope or coated metallic wire or cable. The weight may, again, be made of steel or iron coated with a water impervious material to be approved by the DNR, NSF and/or EPA (or equivalent); or it may be of concrete, which does not need a coating.

The above embodiments are the preferred embodiments, but this invention is not limited thereto. It is, therefore, apparent that many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.